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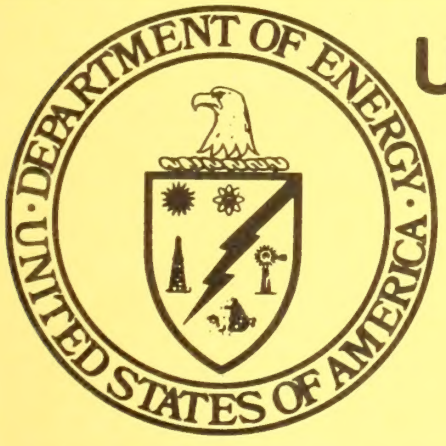
Monthly Performance Report

ALABAMA POWER COMPANY

JUNE 1979



U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

4263

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MONTHLY PERFORMANCE REPORT
ALABAMA POWER COMPANY
JUNE 1979

I. SYSTEM DESCRIPTION

The Alabama Power Company solar energy site is a two and one-half story commercial office building located in Montevallo, Alabama. The building has a floor area of approximately 17,000 square feet. The solar energy system is designed to provide 57 percent of the annual domestic hot water and space heating demands and up to 18 percent of the annual space cooling demand.

The collector subsystem includes four rows of flat plate double glazed collectors. The gross area of the collectors is 2,340 square feet. The collectors are supplemented by two types of reflectors. The rear three rows of the collectors have facing mirrors sloped at 45 degrees from the horizontal while the collectors are sloped at 30 degrees from the horizontal, facing south. All four rows of collectors have vertical mirrors mounted at the tops of the collector frames. The total area of the sloped reflectors is 2,250 square feet and the total area of the vertical reflectors is 740 square feet. The collection transport fluid is water and a drain down method of freeze protection is used. An 8,000 gallon tank is used to store solar energy.

Domestic hot water (DHW) preheating is accomplished by means of a heat exchanger tube passing through the solar storage tank. Solar preheating is supplemented, as required, by a 120-gallon electric water heater.

There are seven independently controlled heating/cooling zones. Each zone is supplied by its own air-handling unit. The air handling units have both hot and cold water lines to allow each unit to be used and controlled independently of the other six parallel units.

Space heating is provided by pumping water from the solar storage tank through heating coils in the air-handling units. The water from solar storage is passed through an electric auxiliary boiler prior to entering the coils of the air-handling units. If the water temperature in the

solar storage tank is too low to meet the heating demand, the electric boiler is used to provide additional heating to the water, as required.

Solar energy used in cooling is provided by passing water directly from the collectors to the generator section of a 25-ton absorption chiller. Auxiliary cooling is provided by a 30-ton electric reciprocating chiller which is used in parallel with the absorption machine. An 8,000-gallon chilled water storage tank is also included in the system. This chilled water storage tank can be supplied by the absorption machine or by the reciprocating chiller during off-peak hours.

The system, shown schematically in Figure 1, has four modes of solar operation.

Mode 1 - Collector to Storage: This mode is enabled by a time clock during daylight hours and it is entered when the temperature of the water at the collector outlet exceeds the temperature of the water in the solar storage tank by approximately 10°F. This temperature differential is adjustable and is to be adjusted for optimum performance based on operational experience. The mode is terminated when the collector outlet temperature no longer exceeds the storage tank temperature by the adjusted value or when the time clock disables the mode logic.

Mode 2 - Collector to Cooling: This mode is entered out of Mode 1 when the collector outlet water temperature reaches or exceeds 165°F. Water from the collectors is diverted directly to the generator section of the absorption chiller before returning to solar storage. Evaporator outlet water is passed to the cooling coils in the air handlers whenever a cooling demand exists. If no cooling demand exists during this mode, the chilled water from the absorption machine passes into the chilled water storage tank. In this mode, the absorption machine functions in parallel with the electric chiller to supply the building cooling load. Since heating and cooling are independently controlled by each zone, it is possible to have this mode and Mode 3 active simultaneously. The mode is terminated when the absorption machine generator inlet water temperature drops to 157°F.

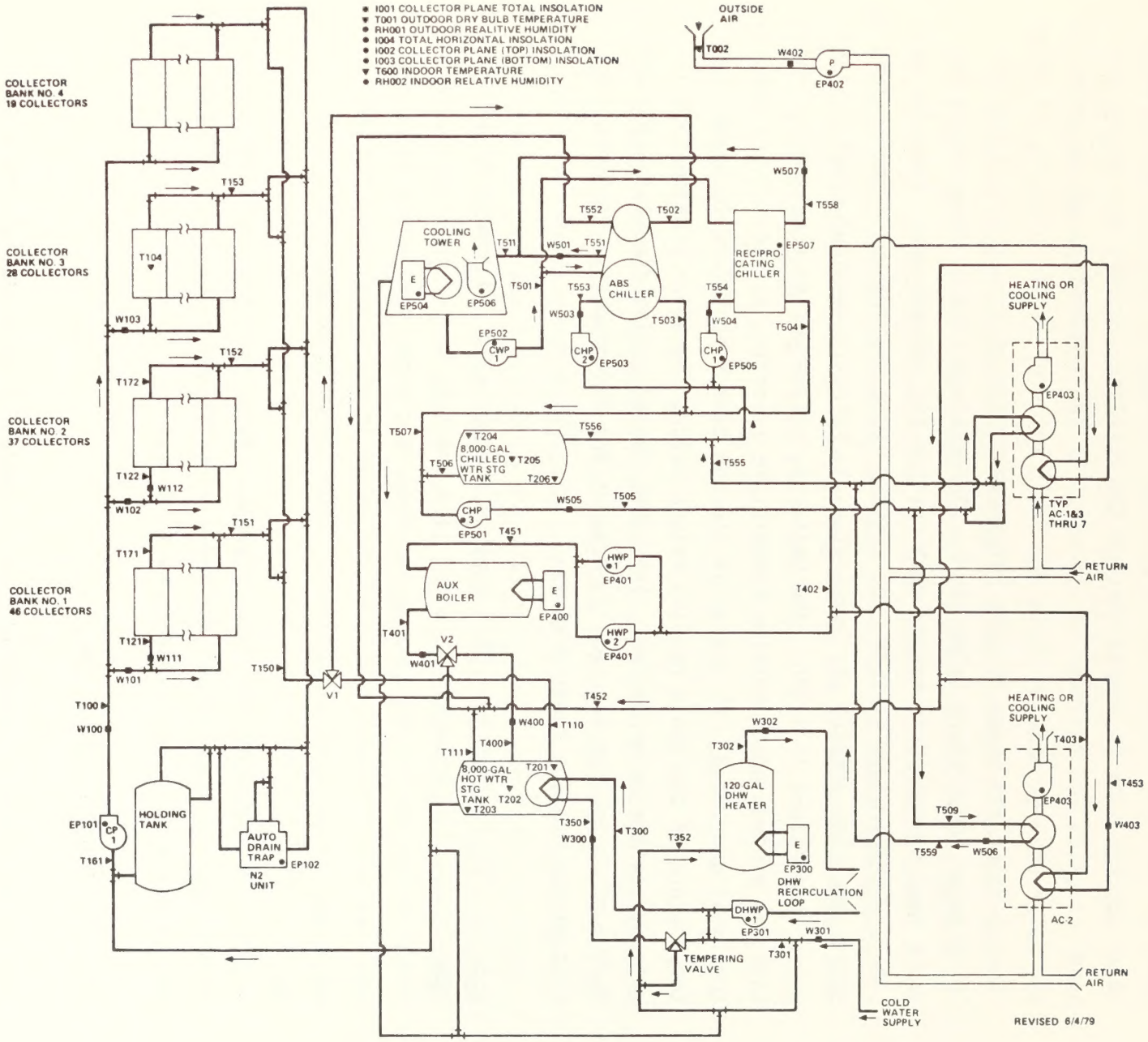

Figure 1. ALABAMA POWER SOLAR ENERGY SYSTEM SCHEMATIC

Mode 3 - Storage to Space Heating: This mode is initiated when a demand for space heating occurs at any of the independently controlled heating/cooling zones or when the outdoor air temperature drops below 65°F. Water from the solar storage tank is pumped through the auxiliary boiler, out to the air handling units and returned to storage. If the temperature of the water in the solar storage tank is above the limit value of 140°F, blending of solar storage water and space heating return water occurs to maintain a boiler inlet water temperature below 140°F. The minimum control temperature for space heating supply is varied with outside air temperature. When the outside air temperature is 65°F, the minimum space heating water temperature is 80°F. When the outside air temperature is 25°F, the minimum space heating water temperature is 120°F. The boiler is activated, as required, to maintain the minimum space heating temperature according to the control temperature just described. If the solar storage tank temperature is below the temperature of the space heating return water, the solar storage tank is bypassed by the return water. This mode can be active simultaneously with Mode 2 since heating and cooling demands are independently determined by each of the heating/cooling zones.

Mode 4 - DHW Preheating: This mode is accomplished independently of the other three solar modes. Incoming city (makeup) water and recirculation return water are passed through a U-tube heat exchanger in the solar storage tank when the temperature of the water in storage exceeds the DHW heat exchanger inlet water temperature. From the heat exchanger the water returns to the 120-gallon DHW tank which contains an electric auxiliary heating element to supplement the solar preheat. Water from the DHW tank is continuously recirculated through the building's hot water lines and returned to the DHW tank via the heat exchanger or directly.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data.

The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The Alabama Power Company solar energy site was in operation during the entire month of June. The solar energy system supplied approximately two percent of the combined loads for DHW, space heating and space cooling. Space cooling was the primary load for the month but none of this load was supported by solar energy since the solar heated water was not hot enough to support absorption cooling.

B. Weather

The average ambient temperature for June was 75°F with an average daytime ambient temperature of 80°F. The long-term average temperature for June is 77°F for the Birmingham, Alabama area. With these warm temperatures, the heating load was expected to be small for June. The total incident insolation on the collector array was 117.82 million Btu for an average of 1,678 Btu/ft^2-day. This was below the June average of 1,831 Btu/ft^2-day derived from long-term data for the Birmingham area.

C. System Thermal Performance

Collector - Of the 117.82 million Btu of solar energy incident upon the collector array during June, 72.11 million Btu were incident when the collector pump (CP1) was operating. The system produced a net collection of 13.63 million Btu, which was 12 percent of the total incident radiation. The net collection of 13.63 million Btu was the result of 17.92 million Btu measured gain through the collectors reduced by a measured rejection of 4.29 million Btu. The relatively high level of energy rejection through the collectors was the result of frequent operation of the collector pump at times when insolation was too low for collection. The operating energy (collector pump power) for the collector subsystem was 2.34 million Btu during June.

Energy Collection and Storage Subsystem - The energy collection and storage subsystem (ECSS) includes the collector array, the solar storage tank and the lines connecting these elements to each other. The ECSS is connected to the load subsystems by supply and return lines. Figure 2 illustrates the ECSS and its energy flow paths. The net input to the ECSS through the collectors was 13.63 million Btu (17.92 million Btu collected, less 4.29 million Btu rejected). The output from the ECSS to the load subsystem connecting lines was 1.82 million Btu and the stored energy level experienced a gain of 1.09 million Btu. Therefore, the total loss of energy from the connecting lines and solar storage tank was 10.72 million Btu.

Storage - The measured input to the solar storage tank was 17.91 million Btu while solar energy was being collected. The total measured output from the solar storage tank was 6.10 million Btu. The measured temperature in the solar storage tank indicated a gain of 1.09 million Btu in stored energy for the month. Therefore, the calculated loss through the walls of the storage tank was 10.72.

Domestic Hot Water Load - The DHW load calculation is based on the flow through the DHW heat exchanger and the temperature difference between the outlet and inlet of the DHW heat exchanger plus the auxiliary electrical energy input to the DHW heater tank. The average temperature maintained at the DHW tank outlet was 132°F during June. The total DHW load for the month was 1.81 million Btu, all of which was supplied by solar energy. Due to the nature of the DHW subsystem and the lack of measurement of the incoming cold water supply volume, this load includes both consumption and sustaining (loss) loads within the recirculating DHW subsystem. Since the operating energy in the DHW subsystem is due solely to the recirculating pump, no operating energy is charged directly to the solar energy system for DHW support.

Space Heating Load - There was no space heating demand for the month of June.

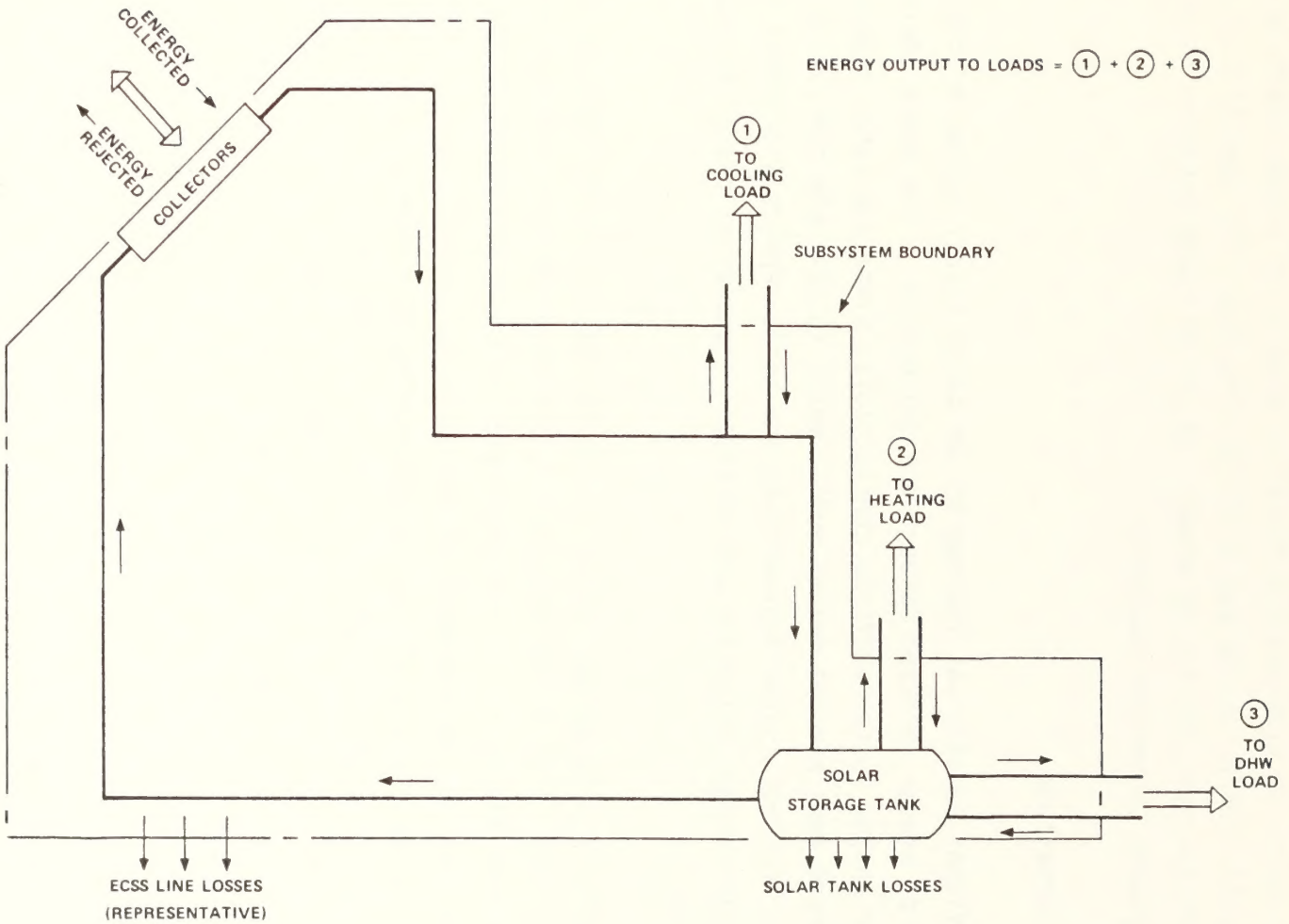

Figure 2. ALABAMA POWER COMPANY ECSS ENERGY FLOW SCHEMATIC

Space Cooling Load - The total space cooling load for June was 95.93 million Btu. A negligible amount of this load was supported by solar energy due to the low temperature of the solar heated water available at the absorption chiller generator inlet. The absorption chiller was active on one day for a short period of time and the operating energy for space cooling charged to the solar energy system was 0.004 million Btu. The operation of the auxiliary electric chiller is summarized in the table entitled "Auxiliary Thermodynamic Conversion Equipment."

D. Observations

A significant penalty was imposed on the solar energy system by the high percentage of energy rejected through the collectors. The space cooling mode of solar energy system suffered considerably, since the water temperature in the storage tank was not raised sufficiently to activate the absorption chiller. Control system improvements and basic repairs are needed to optimize solar energy collection and minimize rejection of energy through the collectors.

The seemingly high energy losses in the hot water storage tank are due to two factors. The first is the expected losses from the tank with two inches of polyurethane insulation. This calculates to be approximately 3.3 million Btu. Secondly, due to the placement of the collector control sensor, collector pumps were activated every half-hour in the morning to determine an accurate collector outlet temperature. During the course of the month, this resulted in a rejection of approximately 7.4 million Btu of energy from the storage tank. Since this amount can only be determined indirectly, it does not enter into calculations for energy delivered from storage, giving an appearance of storage tank energy imbalance. This difficulty is only temporary, since the collector control sensor should be relocated before August 1979.

E. Energy Savings

An electrical loss of 0.53 million Btu was calculated for the Alabama Power Company solar energy system during June. This is due to the fact that more operating energy was charged to the solar portion of the system than was supplied by solar energy. Specifically, more energy was used in pumping water

through the collectors than was gained across the heat exchanger for the DHW load. These were the only contributing factors since there was no solar demand for space heating or cooling during June.

III. ACTION STATUS

None.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

SITE/SYSTEM DESCRIPTION:
ALABAMA POWER SOLAR SYSTEM PROVIDES SUPPORT TO SPACE HEATING, SPACE COOLING AND DOMESTIC HOT WATER SYSTEMS. SOLAR HEATED WATER IS UTILIZED TO DRIVE AN ABSORPTION CHILLER WHICH ASSISTS AN ELECTRIC POWERED CHILLER IN PROVIDING SYSTEM COOLING WATER. HEATED WATER FOR SUPPORTING SPACE HEATING AND DOMESTIC HOT WATER IS STORED IN AN 8000 GALLON CAPACITY TANK. THE DOMESTIC HOT WATER CONTINUOUS RECIRCULATION LOOP INCLUDES FLOW THROUGH A HEAT EXCHANGER LOCATED INSIDE THE STORAGE TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	117.823 MILLION BTU
	50352 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	13.628 MILLION BTU
	5824 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	75 DEGREES F
AVERAGE BUILDING TEMPERATURE	79 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.02
ECSS OPERATING ENERGY	2.339 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	68.811 MILLION BTU
TOTAL ENERGY CONSUMED	106.475 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.814	0.000	95.928	97.742 MILLION BTU
SOLAR FRACTION	100	0	0	2 PERCENT
SOLAR ENERGY USED	1.814	0.000	0.004	1.818 MILLION BTU
OPERATING ENERGY	0.622	0.000	65.851	68.811 MILLION BTU
AUX. THERMAL ENERGY	0.000	0.000	16.825	16.825 MILLION BTU
AUX. ELECTRIC FUEL	0.000	0.000	24.036	24.036 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	1.814	0.000	0.000	-0.525 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.316

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

SITE/SYSTEM DESCRIPTION:
ALABAMA POWER SOLAR SYSTEM PROVIDES SUPPORT TO SPACE HEATING, SPACE COOLING AND DOMESTIC HOT WATER SYSTEMS. SOLAR HEATED WATER IS UTILIZED TO DRIVE AN ABSORPTION CHILLER WHICH ASSISTS AN ELECTRIC POWERED CHILLER IN PROVIDING SYSTEM COOLING WATER. HEATED WATER FOR SUPPORTING SPACE HEATING AND DOMESTIC HOT WATER IS STORED IN AN 8000 GALLON CAPACITY TANK. THE DOMESTIC HOT WATER CONTINUOUS RECIRCULATION LOOP INCLUDES FLOW THROUGH A HEAT EXCHANGER LOCATED INSIDE THE STORAGE TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	124.303 GIGA JOULES
	571796 KJ/SQ.M.
COLLECTED SOLAR ENERGY	14.378 GIGA JOULES
	66138 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	24 DEGREES C
AVERAGE BUILDING TEMPERATURE	26 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.02
ECSS OPERATING ENERGY	2.468 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	72.596 GIGA JOULES
TOTAL ENERGY CONSUMED	112.332 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.914	0.000	101.203	103.117 GIGA JOULES
SOLAR FRACTION	100	0	0	2 PERCENT
SOLAR ENERGY USED	1.914	0.000	0.005	1.919 GIGA JOULES
OPERATING ENERGY	0.656	0.000	69.472	72.596 GIGA JOULES
AUX. THERMAL ENG	0.000	0.000	17.750	17.750 GIGA JOULES
AUX. ELECTRIC FUEL	0.000	0.000	25.358	25.358 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	1.914	0.000	0.000	-0.553 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.316

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	3.644	76	0.103	N	0.113	N	0.028
2	4.096	79	0.113	O	0.083	O	0.027
3	2.806	75	0.092	T	0.000	T	0.033
4	2.890	72	0.092		0.110		0.032
5	4.086	74	0.105	A	0.112	A	0.026
6	3.201	78	0.102	P	0.090	P	0.031
7	3.303	79	0.089	P	0.104	P	0.027
8	3.824	82	0.061	L	0.111	L	0.016
9	4.617	80	0.030	I	0.016	I	0.007
10	4.427	78	0.071	C	0.024	C	0.016
11	5.308	71	0.071	A	0.100	A	0.013
12	5.157	71	0.025	B	0.104	B	0.005
13	4.340	72	0.008	L	0.098	L	0.002
14	4.465	72	0.006	E	0.098	E	0.001
15	4.403	72	0.008		0.101		0.002
16	4.591	71	0.002		0.058		0.001
17	4.215	75	0.006		0.004		0.001
18	3.793	77	0.037		0.093		0.010
19	4.527	80	0.033		0.107		0.007
20	4.675	82	0.006		0.100		0.001
21	2.746	78	0.012		0.094		0.005
22	4.496	79	0.029		0.105		0.006
23	3.082	75	0.007		0.001		0.002
24	3.860	76	0.011		0.007		0.003
25	1.821	68	0.075		0.069		0.041
26	3.148	70	0.104		0.107		0.033
27	4.123	72	0.117		0.101		0.028
28	4.404	75	0.113		0.124		0.026
29	3.227	73	0.200		0.101		0.062
30	4.447	79	0.092		0.003		0.021
SUM	117.823	-	1.822	N.A.	2.339	N.A.	-
AVG	3.927	75	0.061	N.A.	0.078	N.A.	0.015
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	3.644	3.242	0.933	79	0.256
2	4.096	1.197	-0.020	86	-0.005
3	2.806	0.000	0.000	78	0.000
4	2.890	2.458	-0.030	74	-0.010
5	4.086	3.537	1.110	80	0.272
6	3.301	2.756	0.672	80	0.204
7	3.303	2.800	0.403	82	0.122
8	3.824	3.225	0.755	88	0.197
9	4.617	0.000	0.000	84	0.000
10	4.427	0.000	0.000	88	0.000
11	5.308	4.456	1.256	72	0.237
12	5.157	4.442	1.292	78	0.250
13	4.340	3.534	0.543	82	0.125
14	4.465	3.629	0.455	79	0.102
15	4.403	3.624	0.504	77	0.115
16	4.591	2.615	0.653	78	0.142
17	4.215	0.000	-0.129	83	-0.031
18	3.793	3.030	0.693	*	0.183
19	4.527	3.883	0.976	89	0.216
20	4.675	3.993	0.983	89	0.210
21	2.746	1.974	-0.242	82	-0.088
22	4.496	3.850	0.876	85	0.195
23	3.082	0.000	0.000	74	0.000
24	3.860	0.000	-0.023	80	-0.006
25	1.821	1.085	-0.342	68	-0.188
26	3.148	2.597	0.223	73	0.071
27	4.123	3.570	0.994	76	0.241
28	4.404	3.889	0.820	83	0.186
29	3.227	2.622	0.271	78	0.084
30	4.447	0.000	0.000	86	0.000
SUM	117.823	72.108	13.628	-	-
AVG	3.927	2.404	0.454	80	0.116
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PEPIOD: JUNE,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.986	0.155	0.624	130	0.790
2	0.333	0.466	-0.047	137	1.258
3	0.000	0.092	-0.211	135	1.000
4	0.397	0.519	-0.158	130	0.910
5	1.132	0.128	0.699	134	0.730
6	0.748	0.179	0.182	141	0.482
7	0.669	0.355	0.072	143	0.627
8	0.799	0.106	0.372	147	0.597
9	0.000	0.030	-0.442	148	1.000
10	0.000	0.071	-0.427	139	1.000
11	1.428	0.243	0.742	141	0.690
12	1.372	0.105	0.716	152	0.598
13	0.819	0.284	-0.012	159	0.332
14	0.682	0.233	0.037	159	0.397
15	0.604	0.108	-0.092	158	0.026
16	0.751	0.100	-0.042	161	0.078
17	0.000	0.135	-0.488	152	1.000
18	0.787	0.130	0.049	148	0.228
19	1.101	0.159	0.497	154	0.595
20	1.122	0.145	0.441	161	0.522
21	0.020	0.275	-0.925	159	-32.508
22	1.022	0.175	0.438	153	0.599
23	0.000	0.007	-0.306	157	1.000
24	0.000	0.034	-0.638	152	1.000
25	0.006	0.423	-0.865	136	-70.366
26	0.423	0.304	0.004	129	0.728
27	1.119	0.241	0.661	133	0.806
28	1.035	0.328	0.448	143	0.749
29	0.553	0.482	-0.275	144	0.375
30	0.000	0.092	0.036	143	1.000
SUM	17.910	6.104	1.091	-	-
AVG	0.597	0.203	0.036	146	0.402
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: JUNE,1979

SOLAR/2017-79/06

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.103	100	0.103	0.021	0.000	0.000	N	0.103	N	73	122	N
2	0.105	100	0.105	0.020	0.000	0.000	O	0.105	O	76	128	O
3	0.092	100	0.092	0.020	0.000	0.000	T	0.092	T	77	126	T
4	0.092	100	0.092	0.021	0.000	0.000		0.092		75	123	
5	0.105	100	0.105	0.021	0.000	0.000	A	0.105	A	72	125	A
6	0.102	100	0.102	0.021	0.000	0.000	P	0.102	P	75	130	P
7	0.089	100	0.089	0.021	0.000	0.000	P	0.089	P	75	132	P
8	0.061	100	0.061	0.021	0.000	0.000	L	0.061	L	75	134	L
9	0.030	100	0.030	0.021	0.000	0.000	I	0.030	I	80	134	I
10	0.071	100	0.071	0.021	0.000	0.000	C	0.071	C	81	132	C
11	0.071	100	0.071	0.021	0.000	0.000	A	0.071	A	77	132	A
12	0.025	100	0.025	0.020	0.000	0.000	B	0.025	B	77	135	B
13	0.008	100	0.008	0.020	0.000	0.000	L	0.008	L	76	138	L
14	0.006	100	0.006	0.020	0.000	0.000	E	0.006	E	76	137	E
15	0.008	100	0.008	0.020	0.000	0.000		0.008		76	138	
16	0.002	100	0.002	0.020	0.000	0.000		0.002		79	138	
17	0.006	100	0.006	0.020	0.000	0.000		0.006		81	136	
18	0.037	100	0.037	0.021	0.000	0.000		0.037		77	134	
19	0.033	100	0.033	0.021	0.000	0.000		0.033		77	136	
20	0.006	100	0.006	0.021	0.000	0.000		0.006		76	138	
21	0.012	100	0.012	0.021	0.000	0.000		0.012		78	138	
22	0.029	100	0.029	0.021	0.000	0.000		0.029		77	136	
23	0.007	100	0.007	0.021	0.000	0.000		0.007		80	137	
24	0.011	100	0.011	0.021	0.000	0.000		0.011		81	137	
25	0.075	100	0.075	0.021	0.000	0.000		0.075		77	128	
26	0.104	100	0.104	0.021	0.000	0.000		0.104		76	121	
27	0.117	100	0.117	0.021	0.000	0.000		0.117		75	125	
28	0.113	100	0.113	0.021	0.000	0.000		0.113		74	131	
29	0.200	100	0.200	0.021	0.000	0.000		0.200		75	129	
30	0.092	100	0.092	0.021	0.000	0.000		0.092		80	131	
SUM	1.814	-	1.814	0.622	0.000	0.000	N.A.	1.814	N.A.	-	-	N.A.
AVG	0.060	100	0.060	0.021	0.000	0.000	N.A.	0.060	N.A.	77	132	N.A.
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: JUNE,1979

SOLAR/2017-79/06

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	N	0.000	N	76	76
2	0.000	0	0.000	0.000	0.000	0.000	O	0.000	O	78	79
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	80	75
4	0.000	0	0.000	0.000	0.000	0.000		0.000		77	72
5	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	77	74
6	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	77	78
7	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	77	79
8	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	78	82
9	0.000	0	0.000	0.000	0.000	0.000	I	0.000	I	85	80
10	0.000	0	0.000	0.000	0.000	0.000	C	0.000	C	90	78
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	80	71
12	0.000	0	0.000	0.000	0.000	0.000	B	0.000	B	77	71
13	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	77	72
14	0.000	0	0.000	0.000	0.000	0.000	E	0.000	E	77	72
15	0.000	0	0.000	0.000	0.000	0.000		0.000		77	72
16	0.000	0	0.000	0.000	0.000	0.000		0.000		78	71
17	0.000	0	0.000	0.000	0.000	0.000		0.000		80	75
18	0.000	0	0.000	0.000	0.000	0.000		0.000		78	77
19	0.000	0	0.000	0.000	0.000	0.000		0.000		78	80
20	0.000	0	0.000	0.000	0.000	0.000		0.000		78	82
21	0.000	0	0.000	0.000	0.000	0.000		0.000		78	78
22	0.000	0	0.000	0.000	0.000	0.000		0.000		78	79
23	0.000	0	0.000	0.000	0.000	0.000		0.000		83	75
24	0.000	0	0.000	0.000	0.000	0.000		0.000		86	76
25	0.000	0	0.000	0.000	0.000	0.000		0.000		78	68
26	0.000	0	0.000	0.000	0.000	0.000		0.000		77	70
27	0.000	0	0.000	0.000	0.000	0.000		0.000		77	72
28	0.000	0	0.000	0.000	0.000	0.000		0.000		77	75
29	0.000	0	0.000	0.000	0.000	0.000		0.000		77	73
30	0.000	0	0.000	0.000	0.000	0.000		0.000		82	79
SUM	0.000	-	0.000	0.000	0.000	0.000	N.A.	0.000	N.A.	-	-
AVG	0.000	0	0.000	0.000	0.000	0.000	N.A.	0.000	N.A.	79	75
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: JUNE,1979

SOLAR/2017-79/06

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	3.884	0	0.000	2.414	0.669	0.956	N	0.000	N	76	76
2	3.037	0	0.004	2.179	0.479	0.685	O	0.000	O	78	79
3	0.000	0	0.000	1.637	0.000	0.000	T	0.000	T	80	75
4	4.354	0	0.000	2.620	0.842	1.203		0.000		77	72
5	3.680	0	0.000	2.447	0.627	0.896	A	0.000	A	77	74
6	4.065	0	0.000	2.420	0.715	1.022	P	0.000	P	77	78
7	4.228	0	0.000	2.415	0.712	1.017	P	0.000	P	77	79
8	4.752	0	0.000	2.446	0.740	1.058	L	0.000	L	78	82
9	0.044	0	0.000	1.663	0.023	0.032	I	0.000	I	85	80
10	0.000	0	0.000	1.637	0.000	0.000	C	0.000	C	90	78
11	5.769	0	0.000	2.748	1.040	1.486	A	0.000	A	80	71
12	3.879	0	0.000	2.477	0.739	1.056	B	0.000	B	77	71
13	3.962	0	0.000	2.455	0.664	0.948	L	0.000	L	77	72
14	3.552	0	0.000	2.404	0.590	0.842	E	0.000	E	77	72
15	3.667	0	0.000	2.411	0.642	0.918		0.000		77	72
16	2.532	0	0.000	2.188	0.467	0.667		0.000		78	71
17	0.339	0	0.000	1.757	0.096	0.138		0.000		80	75
18	5.337	0	0.000	2.183	0.874	1.249		0.000		78	77
19	4.662	0	0.000	1.592	0.802	1.145		0.000		78	80
20	4.551	0	0.000	1.871	0.770	1.100		0.000		78	82
21	4.439	0	0.000	2.134	0.786	1.123		0.000		78	78
22	4.343	0	0.000	2.355	0.775	1.107		0.000		78	79
23	0.000	0	0.000	1.632	0.000	0.000		0.000		83	75
24	0.723	0	0.000	1.738	0.210	0.300		0.000		86	76
25	4.930	0	0.000	2.630	0.895	1.279		0.000		78	68
26	3.822	0	0.000	2.448	0.655	0.935		0.000		77	70
27	3.533	0	0.000	2.415	0.611	0.873		0.000		77	72
28	4.004	0	0.000	2.493	0.711	1.016		0.000		77	75
29	3.840	0	0.000	2.407	0.690	0.986		0.000		77	73
30	0.000	0	0.000	1.637	0.000	0.000		0.000		82	79
SUM	95.928	-	0.004	65.851	16.825	24.036	N.A.	0.000	N.A.	-	-
AVG	3.198	0	0.000	2.195	0.560	0.801	N.A.	0.000	N.A.	79	75
NBS	Q502	N500	Q500	Q503	Q501		Q508	0512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: JUNE, 1979

SOLAR/2017-79/06

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1557	N	76	79	N	N	N
2	1750	O	79	86	O	O	O
3	1199	T	75	78	T	T	T
4	1235		72	74			
5	1746	A	74	80	A	A	A
6	1411	P	78	80	P	P	P
7	1412	P	79	82	P	P	P
8	1634	L	82	88	L	L	L
9	1973	I	80	84	I	I	I
10	1892	C	78	88	C	C	C
11	2269	A	71	72	A	A	A
12	2204	B	71	78	B	B	B
13	1855	L	72	82	L	L	L
14	1908	E	72	79	E	E	E
15	1892		72	77			
16	1962		71	78			
17	1801		75	83			
18	1621		77	*			
19	1935		80	89			
20	1998		82	89			
21	1174		78	82			
22	1921		79	85			
23	1317		75	74			
24	1650		76	80			
25	778		68	68			
26	1345		70	73			
27	1762		72	76			
28	1882		75	83			
29	1379		73	78			
30	1901		79	86			
SUM	50352	N.A.	-	-	-	-	-
AVG	1678	N.A.	75	80	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	0.000	0.000	0.000	0.000	0.000
2	0.001	0.004	0.000	0.003	0.195
3	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000
SUM	0.001	0.004	0.000	0.003	0.195
AVG	0.000	0.000	0.000	0.000	0.006

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.
NOTE:

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
AUXILIARY STORAGE PERFORMANCE

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	INCREASE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.245	0.381	-0.031	45	0.726
2	0.569	0.079	0.458	47	1.415
3	0.056	0.000	0.029	51	1.000
4	0.223	0.784	-0.481	47	0.897
5	0.114	0.275	0.049	44	0.239
6	0.171	0.294	-0.000	45	0.581
7	0.260	0.157	0.102	47	0.625
8	0.466	0.077	0.346	50	1.514
9	0.022	0.000	0.054	53	1.000
10	0.023	0.000	0.126	54	1.000
11	0.183	0.136	-0.440	53	4.583
12	0.119	0.585	-0.329	46	0.765
13	0.220	0.285	0.072	44	0.521
14	0.201	0.304	-0.023	45	0.737
15	0.196	0.355	-0.031	45	0.642
16	0.456	0.371	0.123	44	0.899
17	0.040	0.000	0.094	47	1.000
18	0.332	0.163	0.260	50	0.447
19	0.226	0.248	0.020	51	0.831
20	0.185	0.223	0.069	52	0.522
21	0.357	0.516	-0.046	52	0.781
22	0.284	0.284	-0.057	51	0.890
23	0.052	0.000	0.086	51	1.000
24	0.041	0.000	-0.280	53	1.000
25	0.263	0.649	-0.280	47	0.838
26	0.230	0.347	0.040	44	0.572
27	0.156	0.290	0.003	44	0.529
28	0.238	0.238	0.043	45	0.578
29	0.171	0.340	-0.097	45	0.788
30	0.031	0.000	0.137	44	1.000
SUM	6.140	7.581	0.105	-	-
AVG	0.205	0.253	0.004	48	0.796

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

4263

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
AUXILIARY THERMODYNAMIC CONVERSION EQUIPMENT

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	3.873	0.956	1.929	3.775	4.052
2	2.705	0.685	1.843	2.671	3.949
3	0.000	0.000	1.637	0.000	0.000
4	4.852	1.203	2.008	4.787	4.034
5	3.599	0.896	1.942	3.458	4.016
6	4.081	1.022	1.934	3.997	4.000
7	4.038	1.017	1.934	3.995	3.970
8	4.280	1.058	1.965	4.237	4.046
9	0.102	0.032	1.647	0.106	3.150
10	0.000	0.000	1.637	0.000	0.000
11	6.298	1.486	2.105	6.146	4.238
12	4.205	1.056	1.967	4.124	3.983
13	3.783	0.948	1.955	3.642	3.993
14	3.503	0.842	1.922	3.419	4.159
15	3.697	0.918	1.926	3.653	4.028
16	2.508	0.667	1.879	2.497	3.761
17	0.335	0.138	1.724	0.352	2.436
18	5.074	1.249	1.589	4.972	4.063
19	4.624	1.145	1.083	4.543	4.038
20	4.490	1.100	1.383	4.384	4.084
21	4.571	1.123	1.650	4.507	4.071
22	4.394	1.107	1.869	4.324	3.968
23	0.000	0.000	1.632	0.000	0.000
24	1.158	0.300	1.697	1.141	3.859
25	5.200	1.279	2.016	5.090	4.064
26	3.774	0.935	1.941	3.701	4.036
27	3.491	0.873	1.927	3.436	3.999
28	3.955	1.016	1.986	3.888	3.892
29	3.927	0.986	1.927	3.866	3.984
30	0.000	0.000	1.637	0.000	0.000
SUM	96.515	24.036	54.290	94.711	-
AVG	3.217	0.801	1.810	3.157	4.016

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.
NOTE:

4263

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